

Schön Scandal

The Schön Scandal made headlines soon after 2001. Unfortunately, the 9/11 event of 2001 dominated the news for a long time and the lesson to be learned here wasn't. This case is noteworthy chiefly because of how highly acclaimed the perpetrator became before his comeuppance. There are so many practicing scientists that cases like this have since recurred. That the discipline of science polices itself is the reason why fraud is always found out. What non-scientists need to appreciate is that the numbers of practicing scientists is large, and that **many** of them are as adept at scientific analysis as the very few public celebrity scientists. According to AAAS, there were 5.8 million science and engineering researchers worldwide in 2006. Every time a major claim is made, many other scientists are attracted by the news and investigate the claims. If either mathematical analysis or experiments designed to reproduce the claims fails to corroborate the claim, the scientific community at large learns about it. Sometimes innocent errors are responsible, but sometimes real fraud is the cause. When lots of collaborators are involved, determining who is principally responsible can be difficult. Researchers come and go. Their collective knowledge, what we call science, is checked and refined and lives on and on.

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Smyrna, Georgia
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The **Schön scandal** concerns German [physicist Jan Hendrik Schön](#) (born 1970 in [Verden](#)) who briefly rose to prominence after a series of apparent breakthroughs with [semiconductors](#) that were later discovered to be fraudulent.^[1] Before he was exposed, Schön had received the [Otto-Klung-Weberbank Prize](#) for Physics and the Braunschweig Prize in 2001 as well as the Outstanding Young Investigator Award of the [Materials Research Society](#) in 2002, which was later rescinded.

The scandal provoked discussion in the scientific community about the degree of responsibility of coauthors and reviewers of [scientific papers](#). The debate centered on whether [peer review](#), traditionally designed to find errors and determine relevance and originality of papers, should also be required to detect deliberate fraud.


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Rise to prominence



 Jan Hendrik Schön while he was a [Bell Labs](#) employee.

Schön's field of research was [condensed matter physics](#) and [nanotechnology](#).^[2] He received his Ph.D. from the [University of Konstanz](#) in 1997. In late 1997 he was hired by [Bell Labs](#), located in [New Jersey, USA](#). There, he worked on electronics in which conventional semiconducting elements (such as [silicon](#)) were replaced by crystalline organic materials. Specific organic materials can conduct electrical currents, and in a so-called [field-effect transistor](#) (a refined implementation of the transistor effect, which was pioneered in 1947 in the same laboratory) the conductance can be switched on or off, a basic function in the field of electronics. Schön however claimed spectacular on/off behavior, far beyond anything achieved thus far with organic materials. His measurements in most cases confirmed various theoretical predictions, for example that the organic materials could be made to display [superconductivity](#) or be used in [lasers](#). The findings were published in prominent scientific publications, including the journals [Science](#) and [Nature](#), and gained worldwide attention. However, no research group anywhere in the world succeeded in reproducing the results claimed by Schön.^[3]

In 2001 he was listed as an author on an average of one newly published research paper every eight days.^[2] In that year he announced in [Nature](#) that he had produced a [transistor](#) on the molecular scale. Schön claimed to have used a thin layer of [organic](#) dye molecules to assemble an [electric circuit](#) that, when acted on by an [electric current](#), behaved as a transistor. The implications of his work were significant. It would have been the beginning of a move away from [silicon](#)-based electronics and towards organic electronics. It would have allowed chips to continue shrinking past the point at which silicon breaks down, and therefore continue [Moore's](#)

[Law](#) for much longer than is currently predicted. It also would have drastically reduced the cost of electronics.

A key element in Schön's claimed successful observation of various physical phenomena in organic materials was in the transistor setup. Specifically, a thin layer of [aluminium oxide](#) which Schön incorporated in the transistors using lab-facilities of the [University of Konstanz](#) in [Germany](#). Although the equipment and materials used were commonly used by laboratories all over the world, no one succeeded in preparing [aluminium oxide](#) layers of similar quality as claimed by Schön.^[3]

Allegations and investigation

As recounted by [Dan Agin](#) in his book *Junk Science*, soon after Schön published his work on single-molecule semiconductors, others in the physics community alleged that his data contained anomalies. Professor Lydia Sohn, then of [Princeton University](#), noticed that two experiments carried out at very different [temperatures](#) had identical [noise](#).^[2] When the editors of *Nature* pointed this out to Schön, he claimed to have accidentally submitted the same graph twice. Professor [Paul McEuen](#) of [Cornell University](#) then found the same noise in a paper describing a third experiment. More research by McEuen, Sohn and other physicists, uncovered a number of examples of duplicate data in Schön's work. This triggered a series of reactions that quickly led [Lucent Technologies](#) (which ran Bell Labs) to start a formal investigation.^[4]

In May 2002, Bell Labs set up a committee to investigate with Professor [Malcolm Beasley](#) of [Stanford University](#) as chair.^[5] The committee obtained information from all of Schön's coauthors, and interviewed the three principal ones (Zhenan Bao, [Bertram Batlogg](#) and Christian Kloc). It examined electronic drafts of the disputed papers which included processed numeric data. The committee requested copies of the raw data but found that Schön had kept no laboratory notebooks. His raw-data files had been erased from his computer. According to Schön the files were erased because his computer had limited hard drive space. In addition, all of his experimental samples had been discarded, or damaged beyond repair.^{[2][5]}

On September 25, 2002, the committee publicly released its report.^[5] The report contained details of 24 allegations of misconduct. They found evidence of Schön's scientific misconduct in at least 16 of them. They found that whole data sets had been reused in a number of different experiments. They also found that some of his graphs, which purportedly had been plotted from experimental data, had instead been produced using mathematical functions.^[5]

The report found that all of the misdeeds had been performed by Schön alone. All of the coauthors (including Bertram Batlogg who was the head of the team) were exonerated of scientific misconduct. This sparked widespread debate^[6] in the scientific community on how the blame for misconduct should be shared among co-authors, particularly when they share significant part of the credit.^[5]

Aftermath and sanctions

Schön acknowledged that the data were incorrect in many of these papers.^[5] He claimed that the substitutions could have occurred by honest mistake. He admitted to having falsified some data and stated he did so to show more convincing evidence for behaviour that he observed.

Experimenters at [Delft University of Technology](#) and the [Thomas J. Watson Research Center](#) have since performed experiments similar to Schön's. They did not obtain similar results.^[2] Even before the allegations had become public, several research groups had tried to reproduce most of his spectacular results in the field of the physics of organic molecular materials without success.^{[4][7]}

Schön returned to Germany and took a job at an engineering firm.^[7] In June 2004 the [University of Konstanz](#) issued a press release stating that Schön's doctoral degree had been revoked due to "dishonourable conduct". Department of Physics spokesman Wolfgang Dieterich called the affair the "biggest fraud in physics in the last 50 years" and said that the "credibility of science had been brought into disrepute".^[8] Schön appealed the ruling, but on October 28, 2009 it was upheld by the University.^{[9][10]} In response, Schön sued the University, and appeared in court to testify on September 23, 2010. The court overturned the University's decision on September 27, 2010 meaning that Schön can keep his doctoral degree. In November 2010 the University moved to appeal the court's ruling.^[11] The state court ruled in September 2011 that the university was correct in revoking his doctorate, and since no appeal is possible, the doctorate remains revoked.^[12]

In October 2004, the [Deutsche Forschungsgemeinschaft](#) (DFG, the German Research Foundation) Joint Committee announced sanctions against him. The former DFG post-doctorate fellow was deprived of his active right to vote in DFG elections or serve on DFG committees for an eight-year period. During that period, Schön will also be unable to serve as a peer reviewer or apply for DFG funds.^[13]

Withdrawn journal papers

On October 31, 2002, [Science](#) withdrew eight papers written by Schön:^[14]

- J. H. Schön, S. Berg, Ch. Kloc, B. Batlogg (2000). "Ambipolar Pentacene Field-Effect Transistors and Inverters". *Science* **287** (5455): 1022–3. [Bibcode 2000Sci...287.1022S](#). [doi:10.1126/science.287.5455.1022](#). [PMID 10669410](#). (Retracted)
- J. H. Schön, Ch. Kloc, R. C. Haddon, B. Batlogg (2000). "A Superconducting Field-Effect Switch". *Science* **288** (5466): 656–8. [doi:10.1126/science.288.5466.656](#). [PMID 10784445](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2000). "Fractional Quantum Hall Effect in Organic Molecular Semiconductors". *Science* **288** (5475): 2338–40. [doi:10.1126/science.288.5475.2338](#). [PMID 17769842](#). (Retracted)
- J. H. Schön, H. Meng, Z. Bao (2000). "An Organic Solid State Injection Laser". *Science* **289** (5479): 599–601. [Bibcode 2000Sci...289..599S](#). [doi:10.1126/science.289.5479.599](#). [PMID 10915617](#). (Retracted)

- J. H. Schön, Ch. Kloc, B. Batlogg (2000). "A Light-Emitting Field-Effect Transistor". *Science* **290** (5493): 963–6. [Bibcode 2000Sci...290..963S](#). [doi:10.1126/science.290.5493.963](#). [PMID 11062124](#). (Retracted)
- J. H. Schön, Ch. Kloc, H. Y. Hwang, B. Batlogg (2001). "Josephson Junctions with Tunable Weak Links". *Science* **292** (5515): 252–4. [doi:10.1126/science.1058812](#). [PMID 11303093](#). (Retracted)
- J. H. Schön, A. Dodabalapur, Ch. Kloc, B. Batlogg (2001). "High-Temperature Superconductivity in Lattice-Expanded C60". *Science* **293** (5539): 2432–4. [Bibcode 2001Sci...293.2432S](#). [doi:10.1126/science.1064773](#). [PMID 11533443](#). (Retracted)
- J. H. Schön, Ch. Kloc, A. Dodabalapur, B. Batlogg (2001). "Field-Effect Modulation of the Conductance of Single Molecules". *Science* **294** (5549): 2138–40. [doi:10.1126/science.1066171](#). [PMID 11701891](#). (Retracted)

On December 20, 2002, [Physical Review](#) withdrew six papers written by Schön:^{[15][16]}

- J. H. Schön, Ch. Kloc, B. Batlogg (2001). "Hole transport in pentacene single crystals". *Physical Review B* **63**: 245201. [Bibcode 2001PhRvB..63x5201S](#). [doi:10.1103/PhysRevB.63.245201](#). (Retracted)
- J. H. Schön, Ch. Kloc, R. Laudise, B. Batlogg (1998). "Electrical properties of single crystals of rigid rodlike conjugated molecules". *Physical Review B* **58**: 12952. [Bibcode 1998PhRvB..5812952S](#). [doi:10.1103/PhysRevB.58.12952](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2000). "Mobile iodine dopants in organic semiconductors". *Physical Review B* **61**: 10803. [Bibcode 2000PhRvB..6110803S](#). [doi:10.1103/PhysRevB.61.10803](#). (Retracted)
- J. H. Schön, Ch. Kloc, D. Fichou, B. Batlogg (2001). "Conjugation length dependence of the charge transport in oligothiophene single crystals". *Physical Review B* **64**: 035209. [Bibcode 2001PhRvB..64c5209S](#). [doi:10.1103/PhysRevB.64.035209](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2001). "Low-temperature transport in high-mobility polycrystalline pentacene field-effect transistors". *Physical Review B* **63**: 125304. [Bibcode 2001PhRvB..6315304S](#). [doi:10.1103/PhysRevB.63.125304](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2001). "Universal Crossover from Band to Hopping Conduction in Molecular Organic Semiconductors". *Physical Review Letters* **86** (17): 3843–6. [Bibcode 2001PhRvL..86.3843S](#). [doi:10.1103/PhysRevLett.86.3843](#). [PMID 11329338](#). (Retracted)

On February 24, 2003, [Applied Physics Letters](#) withdrew four papers written by Schön:^{[17][18][19][20]}

- J. H. Schön, Z. Bao (2002). "Nanoscale organic transistors based on self-assembled monolayers". *Applied Physics Letters* **80** (5): 847. [Bibcode 2002ApPhL..80..847S](#). [doi:10.1063/1.1445804](#). (Retracted)
- J. H. Schön, C. Kloc (2001). "Fast organic electronic circuits based on ambipolar pentacene field-effect transistors". *Applied Physics Letters* **79** (24): 4043. [Bibcode 2001ApPhL..79.4043S](#). [doi:10.1063/1.1426684](#). (Retracted)
- J. H. Schön (2001). "Plastic Josephson junctions". *Applied Physics Letters* **79** (4): 2208. [Bibcode 2001ApPhL..79.2208S](#). [doi:10.1063/1.1408277](#). (Retracted)

- J. H. Schön, C. Kloc, B. Batlogg (2000). "Perylene: A promising organic field-effect transistor material". *Applied Physics Letters* **77** (23): 3776. [Bibcode 2000ApPhL..77.3776S](#). [doi:10.1063/1.1329634](#). (Retracted)

On May 2, 2003, [Science](#) withdrew another paper written by Schön:^[21]

- J. H. Schön, M. Dorget, F. C. Beuran, X. Z. Xu, E. Arushanov, M. Laguës, C. Deville Cavellin (2001). "Field-Induced Superconductivity in a Spin-Ladder Cuprate". *Science* **293** (5539): 2430. [Bibcode 2001Sci...293.2430S](#). [doi:10.1126/science.1064204](#). (Retracted)

On March 20, 2003, [Advanced Materials](#) withdrew two papers written by Schön:^[22]

- J.H. Schön, H. Meng, Z. Bao (2002). "Self-Assembled Monolayer Transistors". *Advanced Materials* **14** (4): 323–326. [doi:10.1002/1521-4095\(20020219\)14:4<323::AID-ADMA323>3.0.CO;2-5](#). (Retracted)
- J. H. Schön, C. Kloc, J. Wildeman, G. Hadziioannou (2001). "Gate-Induced Superconductivity in Oligophenylenevinylene Single Crystals". *Advanced Materials* **13** (16): 1273–1274. [doi:10.1002/1521-4095\(200108\)13:16<1273::AID-ADMA1273>3.0.CO;2-P](#). (Retracted)

On March 5, 2003, [Nature](#) withdrew seven papers written by Schön:^[23]

- J. H. Schön, M. Dorget, F. C. Beuran, X. Z. Zu, E. Arushanov, C. Deville Cavellin, M. Laguës (2001). "Superconductivity in CaCuO₂ as a result of field-effect doping". *Nature* **414** (6862): 434–6. [Bibcode 2001Natur.414..434S](#). [doi:10.1038/35106539](#). [PMID 11719801](#). (Retracted)
- J. H. Schön, Ch. Kloc, T. Siegrist, M. Steigerwald, C. Svensson, B. Batlogg (2001). "Superconductivity in single crystals of the fullerene C₇₀". *Nature* **413** (6858): 831–3. [doi:10.1038/35101577](#). [PMID 11677603](#). (Retracted)
- J. H. Schön, H. Meng, Z. Bao (2001). "Self-assembled monolayer organic field-effect transistors.". *Nature* **413** (6857): 713–6. [Bibcode 2001Natur.413..713S](#). [doi:10.1038/35099520](#). [PMID 11607026](#). (Retracted)
- J. H. Schön, A. Dodabalapur, Z. Bao, Ch. Kloc, O. Schenker, B. Batlogg (2001). "Gate-induced superconductivity in a solution-processed organic polymer film.". *Nature* **410** (6825): 189–92. [Bibcode 2001Natur.410..189S](#). [doi:10.1038/35065565](#). [PMID 11242074](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2000). "Superconductivity at 52 K in hole-doped C₆₀". *Nature* **408** (6812): 549–52. [doi:10.1038/35046008](#). [PMID 11117735](#). (Retracted)
- J. H. Schön, Ch. Kloc, B. Batlogg (2000). "Superconductivity in molecular crystals induced by charge injection.". *Nature* **406** (6797): 702–4. [Bibcode 2000Natur.406..702S](#). [doi:10.1038/35021011](#). [PMID 10963589](#). (Retracted)
- J. H. Schön, Ch. Kloc, E. Bucher, B. Batlogg (2000). "Efficient organic photovoltaic diodes based on doped pentacene.". *Nature* **403** (6768): 408–10. [Bibcode 2000Natur.403..408S](#). [doi:10.1038/35000172](#). [PMID 10667788](#). (Retracted)

Further questionable journal articles

The retraction notices from February 24, 2003 in *Applied Physics Letters* relayed concerns about seven papers written by Schön and published in the *Applied Physics Letters*:^{[17][18][19][20]}

- J. H. Schön, Z. Bao (2002). "Organic insulator/semiconductor heterostructure monolayer transistors". *Applied Physics Letters* **80** (2): 332. [Bibcode 2002ApPhL..80..332S](#). [doi:10.1063/1.1431697](#).
- J. H. Schön, Ch. Kloc, A. Dodabalapur, B. Crone (2001). "Grain boundary transport and vapor sensing in α -sexithiophene". *Applied Physics Letters* **79** (24): 3965. [Bibcode 2001ApPhL..79.3965S](#). [doi:10.1063/1.1423787](#).
- J. H. Schön, C. Kloc (2001). "Charge transport through a single tetracene grain boundary". *Applied Physics Letters* **78** (24): 3821. [Bibcode 2001ApPhL..78.3821S](#). [doi:10.1063/1.1379986](#).
- J. H. Schön, C. Kloc (2001). "Organic metal–semiconductor field-effect phototransistors". *Applied Physics Letters* **78** (22): 3538. [Bibcode 2001ApPhL..78.3538S](#). [doi:10.1063/1.1376666](#).
- J. H. Schön, C. Kloc, B. Batlogg (2000). "Efficient photovoltaic energy conversion in pentacene-based heterojunctions". *Applied Physics Letters* **77** (16): 2473. [Bibcode 2000ApPhL..77.2473S](#). [doi:10.1063/1.1318234](#).
- J. H. Schön, C. Kloc, B. Batlogg (1999). "Reversible gas doping of bulk α -hexathiophene". *Applied Physics Letters* **75** (11): 1556. [Bibcode 1999ApPhL..75.1556S](#). [doi:10.1063/1.124753](#).
- J. H. Schön, Ch. Kloc, R. A. Laudise, B. Batlogg (1998). "Surface and bulk mobilities of oligothiophene single crystals". *Applied Physics Letters* **73** (24): 3574. [Bibcode 1998ApPhL..73.3574S](#). [doi:10.1063/1.122828](#).

The retraction notice from March 20, 2003 in *Advanced Materials* mentions concerns about another paper written by Schön:^[22]

- J. H. Schön, C. Kloc, Z. Bao, B. Batlogg (2000). "Electron Transport in Fluorinated Copper-Phthalocyanine". *Advanced Materials* **12** (20): 1539–1542. [doi:10.1002/1521-4095\(200010\)12:20<1539::AID-ADMA1539>3.0.CO;2-S](#).

See also

- [Academic dishonesty](#)
- [Bogdanov Affair](#)
- [Hwang Woo-suk](#)
- [List of experimental errors and frauds in physics](#)
- [Plastic Fantastic: How the Biggest Fraud in Physics Shook the Scientific World](#)
- [Scientific misconduct](#)

References

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3. [^] ^a ^b Samuel Reich, Eugenie (2009). *Plastic Fantastic: How the Biggest Fraud in Physics Shook the Scientific World*. ISBN 978-0-230-62384-2.
4. [^] ^a ^b Cassuto, Leonard (16 September 2002). ["Big trouble in the world of "Big Physics""](#). Salon.com.
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8. [^] ["Universität Konstanz entzieht Jan Hendrik Schön den Dokortitel"](#) (Press release). University of Konstanz. 2004.
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14. [^] Z. Bao, B. Batlogg, S. Berg, A. Dodabalapur, R. C. Haddon, H. Hwang, C. Kloc, H. Meng and J. H. Schön (2002). "Retraction". *Science* **298** (5595): 961b. doi:10.1126/science.298.5595.961b.
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16. [^] ["Errata"](#). *Physical Review Letters* **8** (28). 31 December 2002.
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18. [^] ^a ^b Jan Hendrik Schön, Christian Kloc (2003). "Retraction: "Fast organic electronic circuits based on ambipolar pentacene field-effect transistors" [Appl. Phys. Lett. 79, 4043 (2001)]". *Applied Physics Letters* **82** (8): 1313. [Bibcode 2003ApPhL..82R1313S](#). doi:10.1063/1.1556138.
19. [^] ^a ^b Jan Hendrik Schön (2003). "Retraction: "Plastic Josephson junctions" [Appl. Phys. Lett. 79, 2208 (2001)]". *Applied Physics Letters* **82** (8): 1313. [Bibcode 2003ApPhL..82S1313S](#). doi:10.1063/1.1556139.

20. ^a ^b J. H. Schön, Ch. Kloc, B. Batlogg (2003). "Retraction: "Perylene: A promising organic field-effect transistor material" [Appl. Phys. Lett. 77, 3776 (2000)]". *Applied Physics Letters* **82** (8): 1313. Bibcode 2003ApPhL..82T1313S. doi:10.1063/1.1556140.
21. ^a Donald Kennedy (2003). "Editorial Retraction". *Science* **300** (5620): 737. doi:10.1126/science.300.5620.737c.
22. ^a ^b Z. Bao, B. Batlogg, G. Hadziioannou, C. Kloc, H. Meng, J. Wildeman (2003). "Retraction Adv. Mater. 6/2003". *Advanced Materials* **15** (6): 478. doi:10.1002/adma.200390130.
23. ^a "Letters to Nature". *Nature* **422** (6927).

Further reading

- Eugenie Samuel Reich, *Plastic Fantastic*, 2009. ISBN 978-0-230-62384-2
- *Physics and Pixie Dust*, David Kaiser – Book review of Plastic Fantastic.
- Dan Agin, *Junk Science: How Politicians, Corporations, and Other Hucksters Betray Us*, 2006. ISBN 0-312-35241-7.
- Gianfranco D'Anna, "*Il Falsario*", a plausible reconstruction (Mursia, Milano July-2010), ISBN 978-88-425-4197-4 (in Italian).

External links

- "[Bell Labs announces results of inquiry into research misconduct](#)" (Press release). *Bell Labs*. 25 September 2002.
- "[The Dark Secret of Hendrik Schön – programme summary](#)". *BBC*. 5 February 2004.
- "[Investigation Finds that One Lucent Physicist Engaged in Scientific Misconduct](#)" *Physics Today*, 2002
- [NPR Science Friday report \(10/18/2002\)](#)
- "[An Interview with Eugenie Samuel Reich](#)". *Sigma Xi*. June 2009. Author who interviewed 126 scientists and journal editors about Schön's frauds.